

CHAPTER 1

INTRODUCTION TO PGS

LESSON PLAN 1

METHOD:

Lecture, conference, and demonstration

TIME ALLOTTED:

1.0 hour

COURSE PRESENTED TO:

- a. BFV crews
- b. Instructors
- c. TSC personnel

TOOLS, EQUIPMENT, AND MATERIALS (Per Student):

- a. TM 9-6920-710-12&P-1
- b. Student Handout (Appendix B)

PERSONNEL:

- a. Primary instructor
- b. Assistant instructor

INSTRUCTIONAL AIDS:

- a. Overhead projector
- b. Viewgraphs (Appendix A)

REFERENCES:

- a. TM 9-6920-710-12&P-1
- b. FM 23-1

APPENDICES:

- Appendix A. Viewgraphs
- Appendix B. Student Handout

1-1. INTRODUCTION.

(5 minutes)

Note. Show Slide 1.

- a. **Reason.** This lesson provides an overview of the Precision Gunnery System (PGS) and this training course so that you are familiar with the history, principles of operation, and safety regulations of the system as well as the general outline of the training course that is to follow.

Note. Show Slide 2.

- b. **Training Objective.** In a classroom environment, given a student handout and TM 9-6920-710-12&P-1, you will learn the purpose of the PGS training course and be familiar with the safety regulations pertaining to the course.
- c. **Procedure.** During this block of instruction we will discuss the purpose, function, and objectives of the PGS training course and the safety regulations pertaining to the course.

1-2. LECTURE/CONFERENCE/DEMONSTRATION.

(40 minutes)

Note. Show Slide 3.

- a. **Purpose of Course.**
 - (1) Train BFV crews to use PGS.
 - (2) Teach instructors to conduct PGS training.
 - (3) Train support personnel to troubleshoot and service PGS.

Note. Show Slides 4 and 5.

- b. **Presentation of PGS Concept.**
 - (1) **Why PGS?** The high cost of training ammunition, environmental impact, lack of range facilities, and crew turnover have reduced the frequency a BFV crew trains with live ammunition. PGS was developed to provide BFV crews with a tool to train precision, degraded, and battle sight gunnery engagements and conduct force-on-force exercises, without using limited resources.
 - (2) **What is PGS?** PGS is a strap-on laser-based training device that allows full crew interaction when conducting precision gunnery training. Unlike other laser-based training devices, PGS allows the crew to train with all components of the BFV fire control system (FCS).

Note. Show Slide 6.

1-2. LECTURE/CONFERENCE/DEMONSTRATION (Con't).

(3) PGS history.

- (a) MILES not precision gunnery training device
- (b) Armor and Infantry Schools developed requirements
- (c) 1986 live fire test
- (d) 1988 first contract awarded
- (e) 1993 new contract awarded
- (f) 1995 fielding begins

Note. Show Slide 7.

(4) PGS provides the following features:

- (a) Full fire control interface
- (b) Replicates 25 mm gun, TOW, and coax engagements
- (c) Realistic simulation of ballistics and time of flight for each ammunition
- (d) Provides realistic TOW simulation for TOW family of missiles
- (e) Visual effects (obscuration, tracer, and burst on target) in gunner's and commander's sights, day and thermal mode.
- (f) Adjustable loading time to replicate actual upload from hull to turret
- (g) Fully transparent to crew during training

Note. Show Slide 8.

(5) PGS provides the following training capabilities:

- (a) Allows crew to engage both stationary and moving targets from a stationary or moving vehicle during panel gunnery or force-on-force exercises
- (b) Can be used for tactical maneuver training including a global positioning system (GPS) for position determination
- (c) Provides tracking training mode for manipulation exercises
- (d) Scaled gunnery training capabilities
- (e) Provides simulated TOW training during live fire of 25 mm gun and coax
- (f) Is tamper resistant to crew interference
- (g) Full AAR capability
- (h) Adjustable ammunition loads

1-2. LECTURE/CONFERENCE/DEMONSTRATION (Con't).

Note. Show Slide 9.

(6) Principles of operation.

- (a) Ammunition is assigned to system by the instructor prior to exercise.
- (b) Ammunition is selected by use of BFV weapon control box.
- (c) Sighting and firing are performed by the crew using normal procedures as for live firing.
- (d) A computer program in the transceiver unit calculates trajectory of fired round based upon firing table data. A flying volume is created around the simulated projectile. Only targets within flying volume equipped with retro reflector/detector units are detected by firing system.
- (e) If a retro reflector/detector unit-equipped target is found within the flying volume, the transceiver unit determines round impact.
- (f) The transceiver unit transmits impact point information to the target system in order for the target to independently evaluate the effect of the round.

Note. Both firing system (g-i) and target system (j-n) are now *independently* evaluating the engagement.

- (g) The firing system calculates the exact impact point in relation to the retro reflector/detector unit positioned on the target.
- (h) After a completed simulation, the transceiver unit transmits MILES information. If the control panel indicates HIT, the transceiver unit transmits MILES information to the target that was hit. If a ground hit is indicated, MILES is transmitted at the ground position that was hit. All MILES information transmitted is IAW the enhanced MILES code structure.
- (i) The firing system presents the result on the control panel and stores the results, including vehicle position, for the AAR on a TDRS memory card within the control panel.
- (j) The target system's retro detector unit (RDU) receives impact point information and ammunition type from the firing system.
- (k) The target system calculates the real impact point on the target from data about aspect angle and turret hull relationship.
- (l) If the round impacted the target, information on probability of kill in the impact point is determined from preprogrammed data in the target system.
- (m) An evaluation of the effect in the target is calculated. The calculation is based upon vulnerability of target, impact point, and ammunition type.
- (n) The result (MISS, HIT, or KILL) is indicated by the target system's retro detector units and together with the vehicle position stored on the TDRS memory card for the AAR.

1-2. LECTURE/CONFERENCE/DEMONSTRATION (Con't).

Note. Show Slide 10.

(7) **PGS is interoperable and compatible with:**

- (a) Tank Weapon Gunnery Simulation System (TWGSS) for M1/M1A1 tanks and AGS.
- (b) Precision Gunnery System (PGS) for LAV.
- (c) MILES systems equipped with retro reflector units.
- (d) Panel targets equipped with retro reflector units and LTIDs.
- (e) ATWESS.

Note. Show Slide 11.

(8) **PGS consists of 3 sub-systems:**

Note. Show Slides 12 and 13.

- (a) Firing system (FS). Includes the part of the system that simulates the firing of a projectile.

- 1. Transceiver unit
- 2. Tracer, burst, obscuration simulator (TBOS)
- 3. Vehicle interface
- 4. Remote system interface (RSI) for vehicle position determination and TWGSS time synchronization

Note. Show Slides 14 and 15.

- (b) Target system (TS). Includes the part of the system that simulates the target vehicle's profile and vulnerability when fired upon during force-on-force exercises.

- 1. Target computer unit
- 2. Retro detector units
- 3. Hull defilade detector units

Note. Show Slides 16, 17, 18, and 19.

1-2. LECTURE/CONFERENCE/DEMONSTRATION (Con't).

- (c) Training Data Retrieval System (TDRS). Includes equipment to perform AAR of PGS training. The AAR equipment consists of a laptop with specific AAR software. The laptop is also used to program training data to PGS prior to exercises. The RSI provides the AAR with a map for the presentation of vehicle position and training results.

1. TDRS computer unit
2. TDRS memory card

Note. How each component functions within PGS will be covered in depth in future lessons.

Note. Show Slides 20 and 21.

c. General Safety Regulations.

- (1) Mount and dismount vehicle over left front or through the back ramp.
- (2) Maintain 3 points of contact while on top of vehicle.
- (3) No smoking within 50 m of vehicle.
- (4) Do not go over or under the gun barrel.
- (5) Ensure turret traverse lock is engaged before installing or removing PGS or before entering turret.
- (6) Ensure vehicle master power switch and turret power switch are in OFF position before installing/removing PGS.
- (7) Ensure proper hearing protection is worn when using pyrotechnics.
- (8) If TOW ATWESS device is used, ensure area is clear 50 m to the rear and 25 m to the sides.

Warning. Transceiver unit has an eye-safety classification of 3A. During operation, DO NOT view the transceiver unit with an unaided eye for an extended period of time. DO NOT AT ANY TIME view the transceiver unit with an aided eye, i.e., optics which magnify from a distance less than 25 m.

- (9) LASER SAFETY: Do not view transceiver unit with optics from a distance of 25 m or closer

Note. Show Slides 22 and 23. (Use only Slide 20 for crew training.)

d. Training Course Outline.

- (1) The course has 11 lessons. The first nine are intended for crews, instructors, and TSC personnel. The additional lessons are intended for instructors, Master Gunners, and TSC personnel only.

1-2. LECTURE/CONFERENCE/DEMONSTRATION (Con't).

- (a) Introduction to PGS
- (b) Preparation of M2/M3
- (c) Preparation for Operation (PMCS)
- (d) Installation of PGS
- (e) Startup and Alignment
- (f) Operation of PGS
- (g) Post Operational Procedures
- (h) Troubleshooting
- (i) Preparation of Targets
- * (j) Operation of Control Gun (CGUN)
- * (k) Presentation of Equipment
- * (l) Training Data Retrieval System (TDRS) Computer Unit
- * (m) Setup
- * (n) Setup of Training Scenarios
- * (o) After Action Review (AAR)

(*Instructors, Master Gunners, and TSC personnel only)

Note. Explain administrative information (class, hours, lunch, absences, etc.).

- (2) The training course can be tailored to individual unit's needs based on time available and proficiency level of personnel receiving training.

1-3. FINAL REVIEW.

(5 minutes)

- a. **Student Questions.**

Note. Show Slide 24.

- b. **Summary of Main Teaching Points.**

- (1) Purpose of Course
- (2) Presentation of PGS concept
- (3) General safety regulations
- (4) Training course outline

Note. Show Slide 25.

- c. **Closing Statement.** This block of instruction has prepared you to understand the concept of PGS and the safety procedures pertaining to its operation. The knowledge gained in this lesson will provide the foundation for future lessons presented in the training course.

APPENDIX A

TO LESSON PLAN 1
INTRODUCTION TO PGS
VIEWGRAPHS

APPENDIX B TO LESSON PLAN 1

INTRODUCTION TO PGS

STUDENT HANDOUT

B-1. PURPOSE OF PGS.

- a. PGS is a vehicle-mounted training device that aids the crew in gaining and improving proficiency in gunnery skills without the expenditure of live ammunition.
- b. Gunnery and tactical training can be conducted anywhere that eye-safe laser firing is permitted.
- c. PGS provides the crew with visual and sound effects which accurately simulate real firing conditions.

B-2. FUNCTIONAL CONFIGURATION.

- a. PGS simulates the firing of the BFV's 25 mm gun, the firing of the coaxially-mounted machine gun, the firing of the TOW missile system, and the effects of a target vehicle being hit.
- b. PGS consists of three subsystems: firing system, target system, and Training Data Retrieval System (TDRS).
 - (1) **Firing system.** PGS simulates the firing ballistic and missile characteristics of ammunition and the visual and sound effects of firing.
 - (2) **Target system.** The target system receives firing information from an attacking weapon, equipped with a laser training device, and notifies the crew of the effects of the attack. The attack could come from another PGS-equipped vehicle, a Tank Weapon Gunnery Simulation System (TWGSS)-equipped tank, or a Multiple Integrated Laser Engagement System (MILES)-equipped unit. An instructor using the control gun (CGUN) can also communicate with the PGS target system.
 - (3) **TDRS.** The TDRS is used to evaluate the effectiveness of the firing engagements whether in a precision gunnery exercise or a tactical training environment. The TDRS provides real time analysis for each round fired and engagement undertaken. For more information on TDRS, refer to TM 9-6920-711-12&P-1.

B-3. FEATURES AND CAPABILITIES.

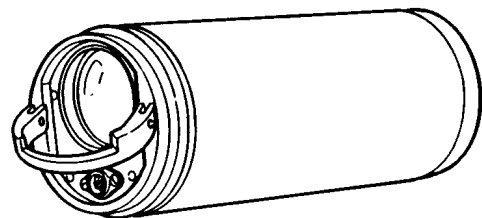
- a. Simulates vehicle firing and ammunition effect on targets.

B-3. FEATURES AND CAPABILITIES (Con't).

- b. Provides full fire control interface to enable the vehicle crew to train using normal engagement techniques.
- c. Provides training capabilities utilizing Class 3A (conditionally eye safe) eye-safe laser.
- d. Interoperable and compatible with TWGSS , MILES, Laser Target Interface Device (LTID), and ATWESS.
- e. Provides panel gunnery training, target tracking training, 1/10 scale target capability, and combat training in a realistic environment with immediate feedback.
- f. Simulates the visual effects of the 25 mm gun, coaxially-mounted machine gun, and TOW missile. These simulations include tracer, tracer burst on target, burst on ground, and obscuration images.
- g. Provides firing sound effects over vehicle intercom to include built-in test (BIT) indications. These sound effects include:
 - (1) 25 mm gunfire signature
 - (2) Coax gunfire signature
 - (3) TOW firing signature
 - (4) Hit indication
 - (5) System error indication
- h. Provides and stores continuously updated vehicle position and time data information.

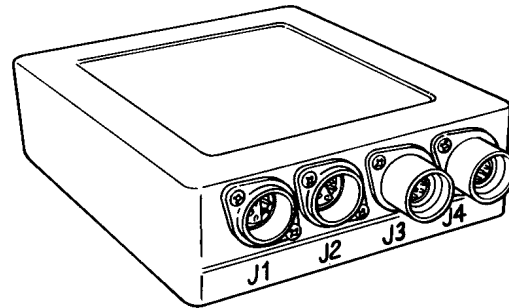
B-4. DESCRIPTION OF MAJOR COMPONENTS.

a. **Transceiver Unit.** Performs the complete weapon effect simulation. The unit is preprogrammed with the physical and operational characteristics of the weapon it is simulating and utilizes lasers to transmit pulses and receive reflections from the targets. The unit determines target position from the laser pulses and transmits the point of impact, type of ammunition, and identity of attacker to the target.

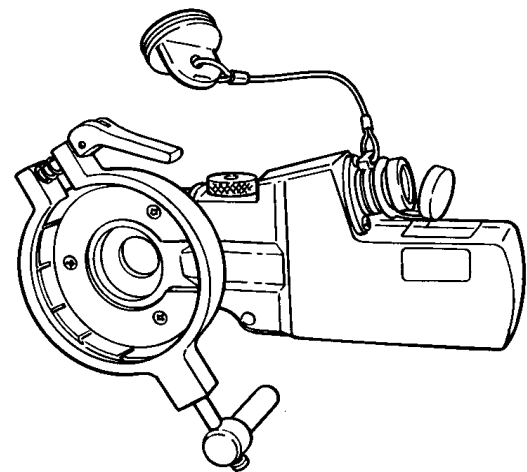


B-4. DESCRIPTION OF MAJOR COMPONENTS (Con't).

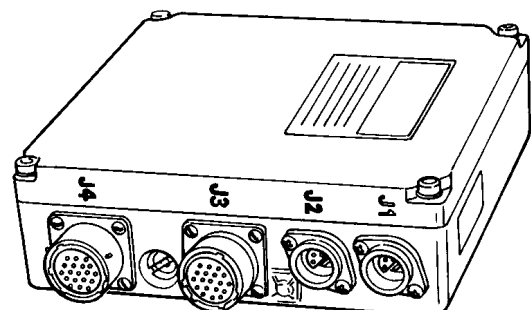
b. **TBOS Driver Unit.** Provides obscuration, tracer, and burst affects simulation into the gunner's and commander's TBOS eyepiece units.



(c) **TBOS Eyepiece Unit.** Provides obscuration, tracer, and target effects simulation into the gunner's and commanders sight pictures.

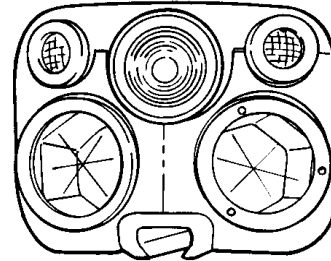


(d) **Target Computer Unit.** Receives results of a simulated firing, including hit point, type of ammunition, and identity of attacker. The unit compares this information with type of target it is programmed to simulate, its size and vulnerability, and determines if there was a near miss, hit, mobility kill, weapon kill, catastrophic kill, or no effect.

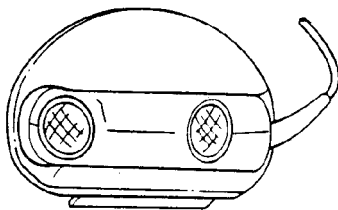


B-4. DESCRIPTION OF MAJOR COMPONENTS (Con't).

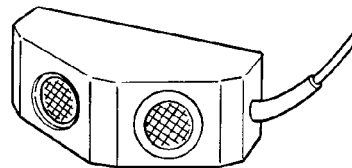
(e) **Retro Detector Unit.** Consists of two reflectors, two laser detectors, and one strobe light: The reflectors reflect laser pulses back to the attacking TWGSS or PGS. The laser detectors receive hit information, including type of ammunition, identity of attacker, and hit point from attacking TWGSS, PGS, or MILES. The strobe light flashes when a vehicle has been hit. Four units are placed high on the turret to provide 360 degrees of coverage.



(f) **Hull Defilade Detector Unit.** Senses hit to hull of vehicle, when vehicle hull is exposed. Four units are placed low on the turret to provide 360 degrees of coverage.

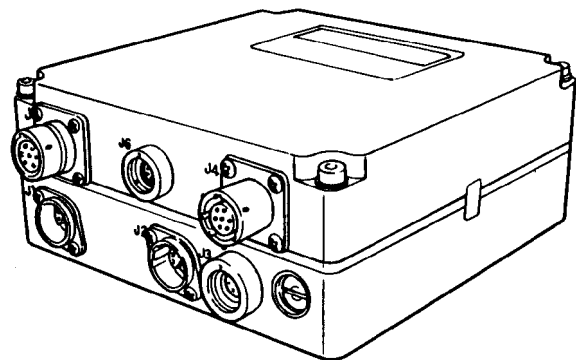


FRONT



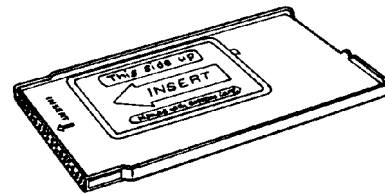
REAR

(g) **Vehicle Interface Unit.** Receives electrical power from the vehicle and distributes power to system components.

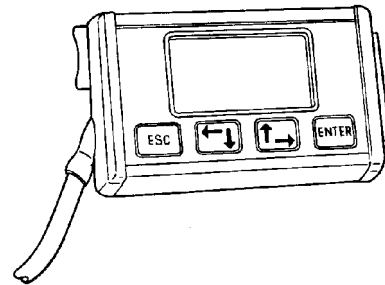


B-4. DESCRIPTION OF MAJOR COMPONENTS (Con't).

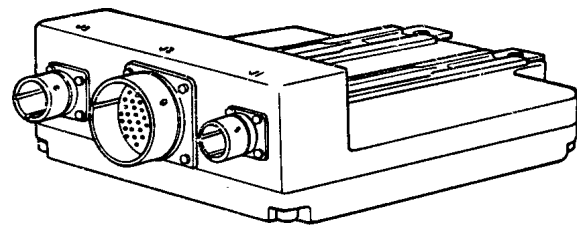
(h) **TDRS Memory Card.** Stores firing and target vehicle application data needed for the intended exercise. Collects and stores exercise events collected during PGS training. The stored training exercise events can be retrieved for After Action Review (AAR) with the TDRS computer unit.



(i) **Control Panel.** Provides the means to manually input required system functions, subfunctions, and options; upload ammo; select training modes; operation system during training; align system prior to training; and view results of firing simulations and BIT error messages.

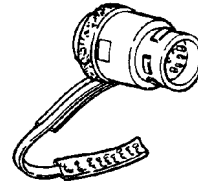


(j) **Expansion Unit.** Receives information from the vehicle regarding turret position and vehicle fire control system status. Receives and sends signals to vehicle fire control system, and provides this information to the vehicle interface unit. Also provides audio indications to vehicle intercom.



B-4. DESCRIPTION OF MAJOR COMPONENTS (Con't).

(k) **Shorting Plug.** Provides a simulated firing of 25 mm gun by isolating the 25 mm gun from its firing circuits.



(l) **Remote System Interface (RSI) Unit.** Receives satellite signals that continuously calculate vehicle position. Provides a means to view and store the vehicle position during a training exercise. The stored vehicle position(s) and time data can be retrieved for After Action Review (AAR) with the TDRS computer unit.

